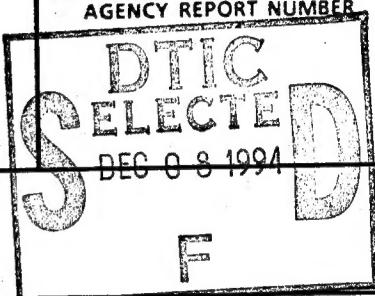
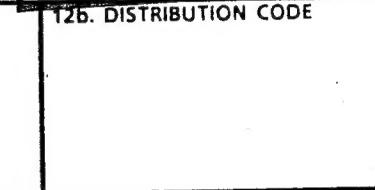


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Siloxane-Based Ferroelectric Liquid Crystal Elastomers and Self-Assembled Mono- and Multilayers

Summary of Accomplishments

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During the project period our work focussed on siloxane-based self-assembled monolayers (SAMs) for liquid crystal alignment. A new method for synthesis of high quality SAMs on float glass was developed. The method is much simpler to use than previous approaches, and most importantly, is ammenable to preparation of SAMs possessing the functionality commonly encountered in ferroelectric liquid crystals (FLCs).

Thus, simple octadecylsiloxane SAMs were prepared by dipping a float glass plate into a toluene solution of octadecyltriethoxysilane in the presence of a catalytic amount of n-butylamine. After 10 min the plate is removed and allowed to stand for 48 hrs. The resulting SAMs were extremely robust, and also of high quality as evidenced by contact angle measurements and atomic force microscopic examination. The approach could also be applied to FLC mesogens possessing triethoxysilyl groupings at a terminal carbon on one of the tails. The FLC-SAMs were more difficult to grow, requiring extended dipping times and heating after removal from the solution. But, they too were of high quality by the standard tests.

The simple alkane SAMs showed unique liquid crystal alignment properties which to our knowledge have never been seen before. Specifically, vigorous uniaxial rubbing of the SAMs gave a very smooth surface which promoted homeotropic nematic alignment, homeotropic alignment in the smectic A phase, and a Schlieren monodomain alignment in the smectic C phase when the two bounding plates were oriented antiparallel. With chiral smectic C* materials, a Schlieren monodomain was obtained with either parallel or antiparallel-oriented bounding plates. This suggests that the LC director tilts parallel to the rubbing direction in a homeotropic sample.

Photolithographic patterning of the surfaces using deep UV light resulted in parallel alignment where the light hit, and homeotropic alignment where no light hit. Such surfaces, when rubbed, gave excellent Schlieren monodomains in the masked areas, and excellent parallel-aligned domains (director along the rubbing direction) in the irradiated regions. This provides unique and powerful control over LC supermolecular structure not obtainable previously. In addition, shorter irradiation times gave pretilted nematics where the degree of pretilt could be controlled by the irradiation time.

Finally, using irradiation and electroless metal deposition, electrodes were placed across homeotropically aligned FLC-SAMs. Application of electric fields, however, did not switch the surface, as evidenced by the fact that the tilt direction of an overlying smectic phase remained oriented along the original rubbing direction after application of fields. Experiments aimed at demonstrating surface switching are still in progress.